



## PARALOID™ AT-410

High-Solids Thermosetting Acrylic Resin  
For Low-Temperature Baking Enamels

### Description

PARALOID AT-410 thermosetting acrylic resin is supplied in methyl n-amyl ketone. It has hydroxyl functionality for reaction with aminoplasts to provide coatings that cure at 250°F uncatalyzed and have an excellent balance of hardness, gloss, flexibility, and resistance properties.

PARALOID AT-410 resin permits the formulator to manufacture coatings at higher solids than those permitted by conventional systems, and at competitive prices. The increased application solids allow the user to spray coatings without the sag problems associated with many high-solids polyesters.

A more accurate statement of the nature of PARALOID AT-410 is the solids measurement at 150°C for one hour rather than the nonvolatiles carried out at 105°C for one hour. However, the nonvolatiles measurement is suitable for VOC or formulating calculations.

### Typical Physical Properties

These properties are typical but do not constitute specifications.

Nonvolatiles, Wt %	73 ± 1
Solids, Wt %	72 ± 1
Solvents	Methyl n-amyl ketone
Viscosity, cps. (Brookfield, 25°C)	3000-6000
Density, lb/U.S. gallon @ 25°C	8.4
Specific gravity, @ 25°C	1.01
Flash Point, SETA Closed Cup, °F (°C)	107 (42)
Appearance	Clear liquid
Color, APHA	500 max.
Hydroxyl Number (solids)	64
Acid Number (solids)	25

## Advantages of PARALOID AT-410

Feature	Benefit
1. High resin solid	Permits application at high volume solids: 50% or higher with conventional room temperature spray.
2. Low temperature cure with polymeric melamine	Save money on lower energy usage.
3. Externally catalyzed cure with monomeric melamine	Lower VOC.
4. Excellent application properties	Provides sag and crater free coatings that resist rinse mark telegraphing.
5. Excellent gloss, image clarity, and color retention	Resists overbake color development and has excellent appearance.
6. Wide range of compatibilities with other solvents and resins	Wide formulation latitude. Can be used to modify polyesters, alkyds, etc.
7. Outstanding stain and solvent resistance	Suitable for appliances.
8. Enamel overspray is less tacky than that of many high solids polyesters	Easier clean-up of paint spray area.

## Film Properties

Enamels based on PARALOID AT-410 resin exhibit higher hardness and gloss with better stain and solvent resistance than enamels based on PARALOID AT-400. In addition, PARALOID AT-410 allows the formulator to achieve higher application solids to help reduce solvent emissions.

## Formulations

PARALOID AT-410 can be formulated in a manner similar to that used for conventional thermosetting acrylic solution resins. A polymeric melamine such as Cymel™ 325 (American Cyanamid) should be used to achieve uncatalyzed cures at 250°F. Where maximum solids are desired, a monomeric melamine such as Cymel 303 should be used, but this will require an external catalyst. To obtain improved flexibility, a polymeric melamine such as Cymel 370 can be used, but with some compromise in aged enamel properties (Table I).

Typical starting point formulations based on PARALOID AT-410 for conventional spray applications are presented in Table III. The small amounts of solvent required to reduce to spray viscosity help to keep the cost competitive with conventional enamels.

## Stability

Enamels based on PARALOID AT-410 resin exhibit excellent viscosity stability (Table II). Film properties of aged enamels formulated with Cymel 325 or Cymel 303 have been found to be comparable to those of freshly prepared samples.

## Spray Application

Enamels based on PARALOID AT-410 resin exhibit excellent conventional spray properties with outstanding sag and crater resistance. The application solids can be formulated at greater than 50% volume solids (see Formulation AT-410-1). They also exhibit an overspray with lower tack than high solids polyesters to allow for easier cleanup.

**Table I: Pigmented Film Properties of Enamels Based on PARALOID AT-410 Versus Enamels Made with PARALOID AT-400 250°F/30 Minute Bake Schedule**

Acrylic Resin	PARALOID AT-410	PARALOID AT-410	PARALOID AT-410	PARALOID AT-410
Melamine	Cymel 325	Cymel 303	Cymel 370	Cymel 325
Acrylic/Melamine Ratio	75/25	75/25	75/25	75/25
Cure Schedule	250°F/30 min.	300°F/20 min.	250°F/30 min.	250°F/30 min.
Substrate	Bonderite™ 1000	Bonderite 1000	Bonderite 1000	Bonderite 1000
<b>A. Mechanical Properties</b>				
Film Thickness	1.1	1.1	1.1	1.1
Tukon Hardness, KHN	19.0	19.5	18.0	15.5
Pencil Hardness	2H-3H	4H	H	2H-3H
Print Resistance (180°F/2 psi/30 min.)	Trace-V. Light	Trace	Light	Trace-V. Light
Gloss, 20°/60°	94/99	92/100	93/99	83/95
Mandrel Flexibility (1/2 in., 1/4 in., 1/8 in.)	0, 1, 3	0, 1, 3	0, 0, 1	0, 0, 1
Impact Resistance, Inch-pounds				
Direct/Reverse	20/2	25/2	20/2	30/2
Crosshatch Tape, % Removal	0	0	0	0
Knife Adhesion	Good	Good	Good	Good
<b>B. Resistance Properties</b>				
Solvent Resistance (15 min.)				
Initial Hardness (Pencil)	3H	4H	H	2H
Xylene	2H	2H	6B	6B
Alkali Resistance (1 hr.)				
10% NaOH	No effect	No effect	No effect	No effect
Acid Resistance (1 hr.)				
10% Acetic Acid	No effect	No effect	No effect	No effect
Stain Resistance (30 min.)				
Lipstick	None	None	None	Trace
Mustard	None	None	None	None
Ball-point ink	Trace-V. Light	None	Moderate	Light

**Table II: Stability of Enamels Based on PARALOID AT-410 Acrylic/Melamine Ratio = 75/25**

Melamine	Cymel 325	Cymel 303	Cymel 370
Solids, wt. %	70	72	70
Viscosity, seconds (No. 4 Ford Cup, 25°C)			
Initial	66	73	53
120°F/7 days	—	115	—
140°F/7 days	114	—	79
% Viscosity Increase	73	58	49

**Table III: Conventional Spray White Baking Enamel Based on PARALOID AT-410**

<b>Sand Mill Grind (15 Minutes)</b>	<b>Formulation AT-410-1</b>		<b>Formulation AT-410-2</b>		<b>Formulation AT-410-3</b>		
	<b>Pounds</b>	<b>Gallons</b>	<b>Pounds</b>	<b>Gallons</b>	<b>Pounds</b>	<b>Gallons</b>	
Ti-Pure™ R-9021	339.0	9.90	351.0	10.25	339.0	9.90	
PARALOID AT-410	204.3	24.33	211.5	25.19	204.3	24.33	
(73% nonvolatiles)							
n-Butanol	98.4	14.65	128.7	19.15	110.2	16.39	
Methyl n-amyl ketone	36.3	5.36	10.8	1.59	24.5	3.62	
Sand — 700 parts by weight							
	Total	678.0	54.24	702.0	56.18	678.0	54.24
	% Solids	72.0		72.0		72.0	
<b>Storage Enamel</b>	<b>Pounds</b>	<b>Gallons</b>	<b>Pounds</b>	<b>Gallons</b>	<b>Pounds</b>	<b>Gallons</b>	
Sand Grind	678.0	54.24	702.0	56.18	678.0	54.24	
PARALOID AT-410	221.4	26.36	229.2	27.30	221.4	26.36	
Cymel 325 <sup>2</sup>	129.5	13.92	—	—	—	—	
Cymel 303 <sup>2</sup>			107.3	10.73	—	—	
Cymel 370 <sup>2</sup>	—	—	—	—	117.7	12.01	
Methyl n-amyl ketone	16.9	2.50	15.9	2.35	28.7	4.24	
PM acetate	29.6	3.67	25.7	3.19	29.6	3.67	
Dow 57 <sup>3</sup>	0.8	0.11	0.8	0.11	0.8	0.11	
Catalyst 4040 (40% pTSA) <sup>2</sup>	—	—	5.4	0.67	—	—	
	Total	1076.2	100.80	1086.3	100.53	1076.2	100.63

**Formulation Constants for Storage Enamel**

Pigment/Binder Ratio	45/55	45/55	45/55
PARALOID AT-410/Melamine (Solids Ratio)	75/25	75/25	75/25
% Alcohol on total resin solids	30	30	30
% Catalyst 4040 on total resin solids	—	1.25	—
Enamel Solids, wt. %	70.0	72.0	70.0
Enamel Solids, vol. %	53.8	56.1	53.6
Enamel Viscosity, seconds (No. 4 Ford Cup @ 25°C)	66	73	53

**Application Constants for Spray Enamel<sup>4</sup>**

Spray Solids, wt. %	67.0	69.0	68.0
Spray Solids, volume %	50.3	52.6	51.3
Spray Viscosity, seconds (No. 4 Ford Cup @ 25°C)	38	38	38
VOC (Calculated) lb/gallon	3.44	3.27	3.37

<sup>1</sup>DuPont<sup>2</sup>American Cyanamid<sup>3</sup>Dow Corning 57 Paint Additive is prediluted to a 10% solution in xylene or other suitable solvent.<sup>4</sup>Reduce enamel from storage viscosity to 35-40 seconds (No. 4 Ford Cup) spray viscosity with methyl n-amyl ketone/PM acetate (85/15).

## Safe Handling Information

Based on toxicity testing conducted on a closely related analog, PARALOID AT-410 is expected to be essentially non-toxic via single acute oral exposure and slightly to moderately toxic by single acute dermal or inhalation exposure. The data also suggest that PARALOID AT-410 may be slightly irritating to the skin, eyes, and respiratory tract. Sufficient ventilation should be employed to maintain methyl-n-amyI ketone air level below its current TLV value.

Some of the other materials recommended for use with PARALOID AT-410 in this bulletin can pose varying degrees of environmental fire or health hazards if improperly used or disposed of. For example, melamine-formaldehyde resins, such as the Cymel products, are capable of releasing free formaldehyde, a suspected animal carcinogen, under some processing conditions. It is important to use good ventilation when working with these products.

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MSDS should be obtained from suppliers of other materials recommended in this bulletin.

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